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-Content for Post Graduate Courses

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Module : 12 Technology based indicators

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Unit 12

Technology based Indicators

I. Objectives

- to understand the basic concept of patent and its role as technology indicator. Further explore patent based indicators in the context of their construction and application.

II. Module Structure

1. Introduction
2. Salient Aspect of Patent/Patenting System
3. Information Content of Patent Document
4. The International Patent Classification (IPC)
5. Patent Citation (References)
6. What can we measure from patents?
7. Summary
8. References

1. Introduction

Patent is considered the most important technology indicator as generally the first choice of any inventor is to protect her/his invention by filing a patent. It is a legal document that gives the holder property rights to the invention i.e. the claim the patent office has approved. Patent specifications provide a detailed description of the technology for which protection is claimed. By identifying patents filed/granted in a particular technology field, the state of art in any technology and how the technology has developed in the said field can be observed.

Standard is another indicator which is gaining in importance as technology indicator. A technology standard can be viewed as “a set of specifications to which all elements of products, processes, formats, or procedures under its jurisdiction must conform”. Particularly in ICT (Information Communication Technology) standards are playing an important role in defining technological competence. But standard is still in early stages of being used as technology indicator because of its complexity, not available

in a systematic/organised manner and uncertainty of its proper relationship with technology. Design registration captures unique designs of products and thus is useful indicator of design innovation. However it does not capture the inventive process and thus not a proper indicator to capture technological activity. Trademark is attached to a product and has strong connection with the market. One can trace new products coming in the market through Trademark registrations. But it is difficult to estimate the technological novelty through Trademark registrations. Keeping in view the limitations of other technology indicators, the module restricts itself to patent based indicators.

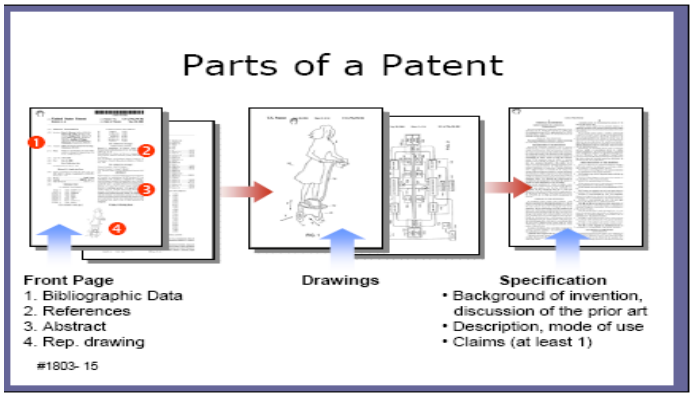
2. Salient Aspect of Patent/Patenting System

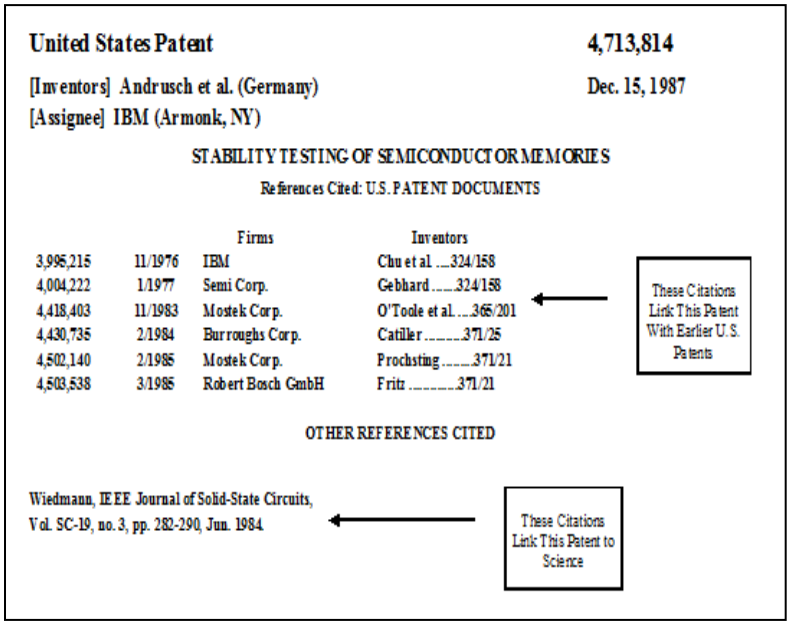
- A patent is a document granting the right to exclude anyone else from the production or use of a specific invention for a stated number of years. Patent is granted for twenty years from the date of filing of the patent. Patent is to be filed in a country's patent office in which protection for invention is sought and there is no world-wide patent protection;

- The purpose of the patent system is twofold (a) to encourage inventor by providing temporary monopoly power to the inventor and, (b) promote the inventive/innovative activity by forcing the inventor to give detailed disclosure of the invention;

- Major patent offices are: Europe: European Patent Office (EPO); United States Patents and Trademarks Office (USPTO); Japan Patent Office (JPO). The patents filed in these three patent offices together are called Triadic patent. The patent profile of these three patent offices broadly indicates the technology trend globally. TRIADIC PATENTS covers patents which have been simultaneously filed in the EPO, USPTO and JPO; and

Patent is granted/issued to the inventor after an examination that focuses on both the novelty (Primarily the check is no prior-art is visible which covers the invention for which protection is sought. Research papers and other filed/granted patents essentially checks for novelty.), non-obviousness (Inventiveness i.e. should not be 'obvious' in other words patent examiner should be able to distinguish that a certain amount of creativity/ingenuity has been involved in the whole process. Reference to published documents plays an important role for 'obvious' check) and should indicate practical utility.





Front page of Patent Document*

* This is the Front page of a US patent document. Patent document of any country essentially has these features in their specification. However, India Patent office does not explicitly include the references they have consulted for checking the novelty and inventiveness of the patent. This important information provided by the US Patent Office patent specification helps to

capture the linkages of this patent with other references. Patent citation linkage analysis is similar to research paper citation analysis.

The above is a typical patent document of the US patent office. The general structures of patent document of different patent office's including that of Indian patent office largely resemble this structure. The Front page of a patent document contains the bibliographic details and are primarily used for constructing patent based indicators

3. Information Content of Patent Document

- **Information related to the history of the application:** Priority date and country of priority (date of first filing of the patent world-wide); Date of filing in the country concerned; Date of grant; Countries in which protection being sought; Date of publication (18 months after grant); Types of patent (Utility, Design or Plant Patent). Utility patents cover the functional attributes of an invention. Generally when the term patent is mentioned it is usually meant as Utility patent. Design patents provide protection only for the ornamental appearance of a useful product. Plant patent protects distinct and new variety of plants. In the Indian Patent Office only Utility patents can be filed.

- **Information related to the development of the invention:** The list of inventors (individuals), their address and country of residence; the legal owners of the patent

- **Information related to the technical features of the invention:** The list of 'claims' describes the innovative content of the given invention thus defining the patent's field of coverage; Technical classification to which the patent belongs (IPC code1); Cited patents (each patent lists prior art relevant to the invention, which is usually described in other patents); Scientific papers cited2.

4. The International Patent Classification (IPC)

The International Patent Classification (IPC) provides a hierarchical system of language independent symbols for the classification of patents according to the different areas of technology to which they pertain. In order to keep the IPC up to date, it is continuously revised and a new version is regularly published.

Retrieval System: Mainly for inventions claimed and some significant information available in description; addresses each technical object to which a patent relates; a combined function/application classification system in which the function takes

[1] For details of IPC refer next section and website: http://www.wipo.int/classifications/ipc/en/general/preface.html

[2] For details related to citations refer next section

precedence; a Tiered Structure: Sections, Classes, Subclasses, Groups and Subgroups.

Analytical Applications of IPC: Identification of technical classes to which a patent belong, group patents which belong to same technical class, group patents covering a sector or link patents to production/trade.

5. Patent Citation (References)

References to prior technology, either patents or other scientific literature on which the current patent builds or which it uses. Citations are in two places in a patent document − examiner citation and citation given by the applicants. Applicants citation is used by the applicant to describe the background of the invention, genesis and provide evidence why said invention is novel and non-obvious. Along with the requirement to describe the invention properly, applicants provide citations to avoid infringement (limit scope, defense against suits).

Examiner citations have a legal role in judging the novelty and non-obviousness of an invention covered by the patent:

- If references lead to claim(s), those claim(s) are not approved.
- If references make the claim/claims obvious, then those claim/claims are not granted.
- If references make all the claims, then that patent is not granted.

Examiner citations may cover a large portion of citations given by applicants.

US patent document provides explicit documentation. Examiner citations are in the front page which is used for judging the novelty and inventiveness of the invention. This explicit referencing allows detailed citation analysis of US patent document. This explicit documentation is not available in the patent specification of the Indian Patent Office.

USPTO differs from EPO in citation practice: USPTO provides all relevant citations while EPO provides minimum number of citations needed to cover the prior art. In other patent offices such as Indian Patent Office, the citations are generally not given explicitly.

6. What can we measure from patents?

The level of research and innovation activities: Correlation between R&D and patents.

Types of innovations and technological compétences of organisations: The description of patented technologies and the correspondions IPC codes can be used to distinguish between different types of technological innovations. Patents are also a good indicator of the directions of research and of the technological competencies of organizations (ex: patent portfolios of firms).

Technology strengths of nations: The technological position of nations in any technology field can be analyzed through patent data. The national patent share in a

particular technological field w.r.t. the overall number of patents in that field allows for a ranking of countries.

Technology diffusion: Patent data are avalable from many different countries and can be used to track patterns of diffusion. Data on multiple filings of patents (patent family size) can be used as an indirect measure of the value of innovation and of its diffusion across countries.

Bibliographic data on patents (identify of the inventor and of the assignee) and joint patent applications can be used to study the sources of innovation and the distribution of patents across organizations (role of collaborations, mapping of networks of innovators).

Technological spillovers and knowledge relatedness**:** Patent citations can be used as indicators of knowledge flows and spillovers across innovations. To capture the cumulativeness and dynamic character of innovation.

Value and novelty of innovation**:** It can be assessed through citations received from other patents or through expert evaluation.

Science – Technology Linkage : The intensity of references/citations in the patent document to research articles provide indication of the extent of scientific research that have lead to the patent.

Strengths of patent based indicators: Long historical time series available; publicly available (no secrecy problems); relatively consistent over time; classification by technical field is possible; and citation analysis is possible

Some of the Patent based Indicators:

- Number of Patents Granted by a patent office (say the Indian Patent Office) to a country/firm/research organisation to identify intensity of technological activity (patent acting as 'proxy' for technological activity);

- Number of patents in a technology class / in a sector by a country/firm/research organisation identify technological competency. Further normalized to show more accurately the technology competency (see below Relative Technological Advantage);

- Relative share of country patents w.r.t to world output year-wise (or for a chosen period) to identify country's technological activity globally;

- Cites Per Patent: A count of citations received by a company's patents (for example year-wise or other-wise). The assumption is that Patents that receive more citations are Technological important patents;

- Number of claims: The number of claims provides an indication of the legal breadth of patent protection. It is a sign of the complexity of a patent. One could argue that the breadth and complexity it implies should coincide with value;

- Number of inventors: This indicator is based on the hypothesis that a patent resulting from the research of several inventors should be more valuable than a patent which was developed by a single invent to;

- Number of IPC classes: This indicator concerns the scope or breadth of a patent in terms of technology classes;

- Technological specialization profile of the countries according to International Patent Classification (IPC) as percentage distribution of patents;

- Current Impact Index: Measure based on how often a company's patents are cited by other patents. The number of times a company's most recent five years of patents are cited in the current year, relative to the entire patent database. It is a synchronous indicator, looking backwards from the current year to the previous five years; thus sensitive to a company's current technology;

- Technology Strength: The number of patents times the current impact index (will indicate the technology strength of a company's newly issued patents); and

- Relative Technological Advantage (RTA): Number of indicators like patent shares, growth rate are used to compare national technological performance but the problem with them is that they do not take into account the different propensity to patent in US among different countries. RTA corrects this bias.

  $RTA_{ij} = \frac{\Sigma_i \Sigma_j \frac{Pij}{Pj}}{\Sigma_i \frac{Pi}{P}}$ where P_{ij} = number of patents of firm j in sector i; P_j= number of patents of firm j in all areas; P_i= number of patents of the country in sector i; P=total patents of the country

RTA_{ij} greater than one indicates higher activity/specialisation and vice-versa (with respect to the country's strength).

- Technology Cycle Time: The median age of the patent references cited in the company's new patents; and

- Science linkage: The average number of science papers referenced in the patents provides an indication of linkage between technology and science. Due

to detailed availability in the US patent documents this input indicator is generally used for US patent office.

Scientific Intensity (of a country/firm) = Number of Patents (of a country or firm) × Science linkage can also be used to judge which field is more science intensive than the other.

One of the useful ways to identify patents within a technology field/research areas is through a Three Phase Model (Narin, et al. 1993)

- Technology Plane itself, where the activity under scrutiny is occurring;
- A precursor or base plane where earlier, cited research has occurred; and
- A successor citing patents, encompassing new applications or variations of the central technology.

(The lines among the successor, technology, and base planes are very thin; it is one of classification and judgment).

The three planes represent closely related areas. They may also represent particularly in the successor plane, leading indicators of future activity.

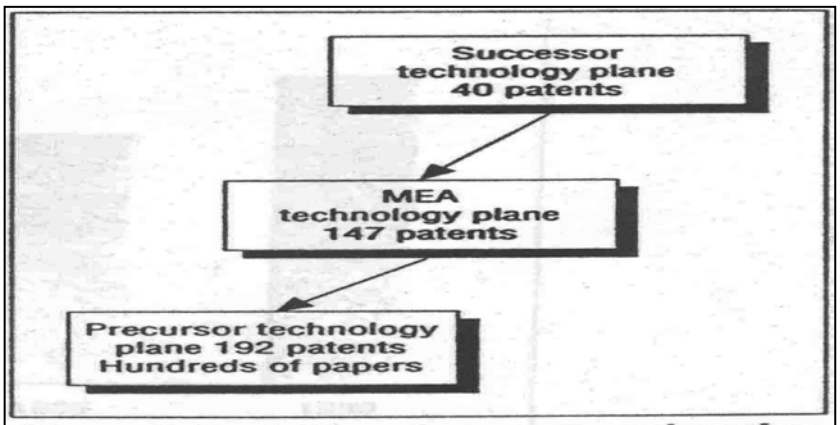


Figure 1. **Evolution of memory-enhancing agent (MEA) technology.**

Advantages and disadvantages of patents as a science and technology metric

Strengths and benefits	Weaknesses and problems
• Patent databases have been in existence for many years.	• Patents do not always lead to commercial applications
• Availability of patent statistics over long period of time allows assessment of technological activity/trend	• Patents are only a small portion of the actual R&D and S&T effort
• Patent data are relatively easy to	• Patents reveal only selected information

Strengths and benefits	Weaknesses and problems
manipulate	about S&T
• Patent data can be related to other economic/financial measures	• Economic value of patents is highly skewed
• Patent data have a similar structure as a legal document	• Propensities to patent varies from one field of technology to another
• Contain revealing information	• Differences among national patent system.
• Indicate levels of S&T effort	• There is a lack of a theory to explain how patents contribute to performance and to strategic advantages
• Similar items of information facilitate cross industry and even cross national comparison	
• Considered as a link between S&T and firm performance, patents offer an elegant way of establishing such a link	
• Patents are viewed as measures of the knowledge base	
• Patents are viewed as measures of the quality of S&T	

Source: Geisler (2000), author's own construction

Examples of India's Patenting Activity

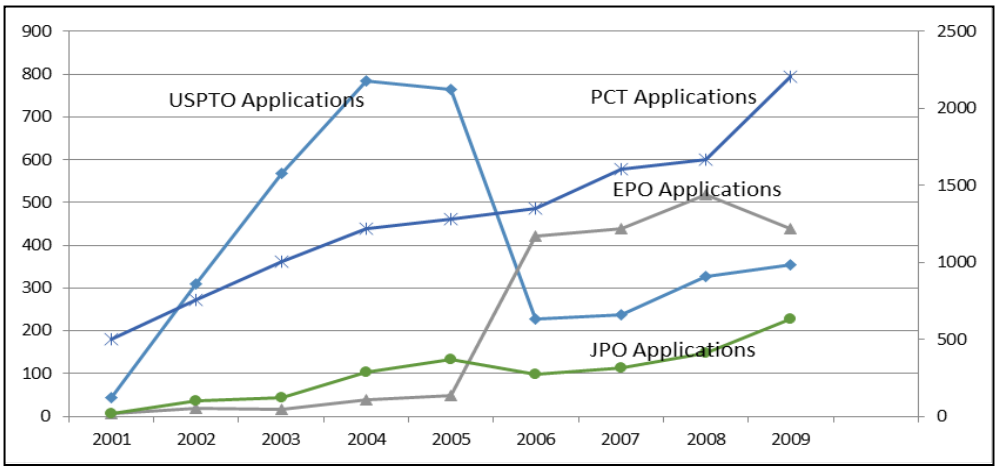


Fig. 1: Trend of Indian patent applications in the major patent offices

Note: Right axis: PCT and Applications; Left axis: USPTO, EPO Applications, and JPO Applications

USPTO (US Patent Office), EPO (European Patent Office) and JPO (Japanese Patent Office), PCT (Patent Cooperation Treaty)

It can be observed that filing through PCT is now the major filing route of Indian inventors for international filing. PCT provides a system thorough which a member country (India is a member country) can file patent applications to different patent offices. This one central assess point for filing helps to overcome the problem of filing separately in each patent office and reduces cost. However, PCT is not a granting institution and hence each patent during PCT filing is required to be marked to which of the patent offices the patent has to reach for examination and granting. Patent filing directly through US patent office has significantly reduced as PCT filing is less costly and can allow multiple filing in different countries.

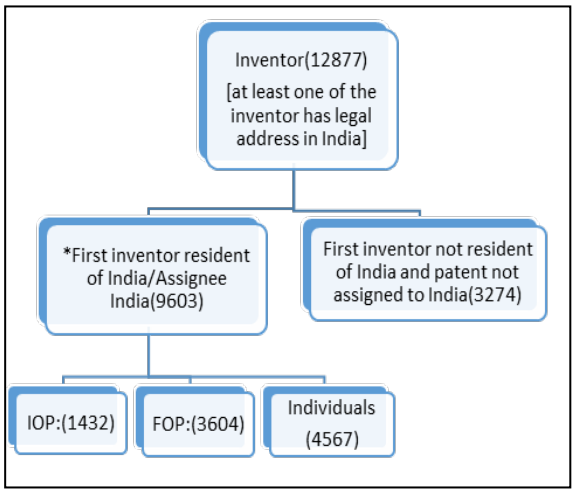


Fig. 2: Patent Applications with One of the Applicants from India in the USPTO (2000-09)

*In international attribution of country-wise patents, these patents are assigned to India. IOP: Indian entities; FOP: Foreign R&D Centers in India; Individuals: Patents filed by individual inventors (many of these patents are from inventors from organisations. Applications do not show their affiliations and hence treated as individual filing as per universal norm)

Distinguishing overall patent filing among different categories is useful to delineate major contributors. For example the above figure shows that Foreign R&D centers in India are major contributors to Indian patenting activity.

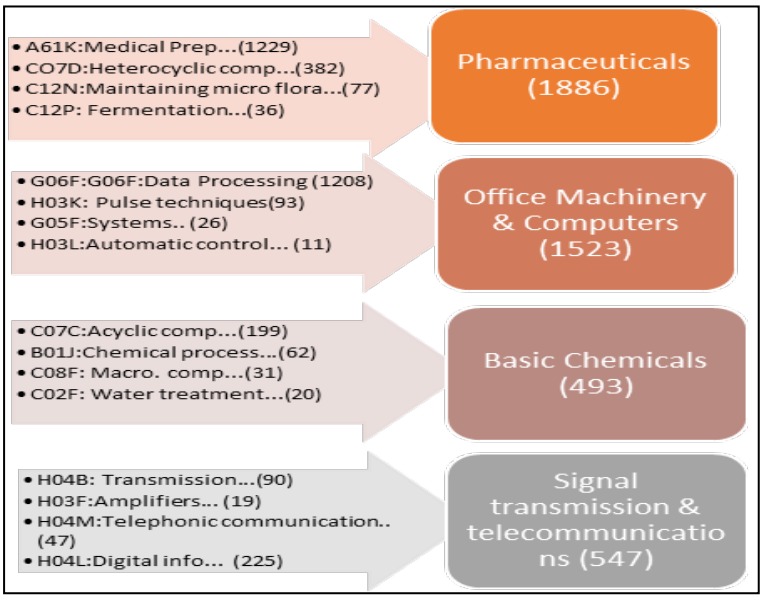


Fig. 3: Dominant Areas of Patent Filing by Indian Entities in the USPTO (2000-09)

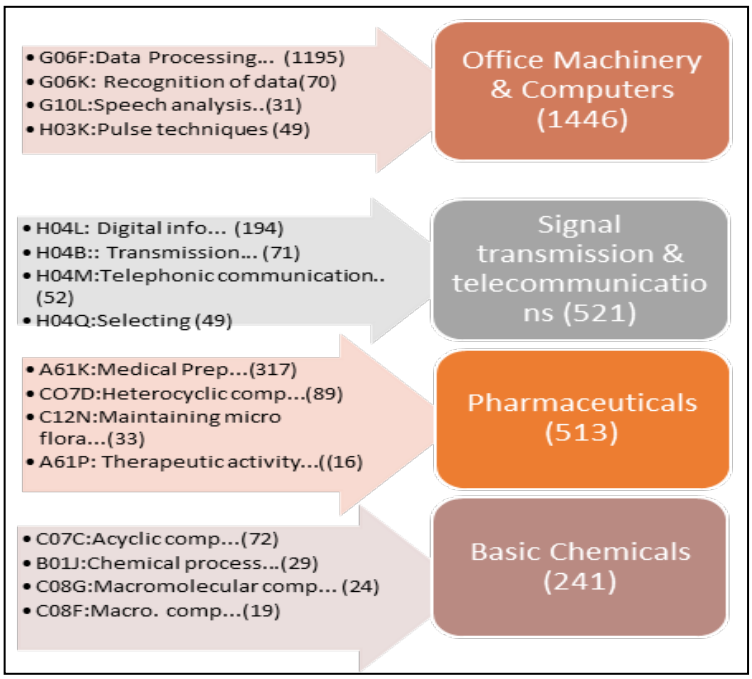


Fig.4: Dominant Areas of Patent Filing by Foreign R&D Centers in India in the USPTO (2000-09)

Fig. 3 and 4 highlights the thrust areas of patent focus of Indian entities (Indian firms, academia and research organisations) and Foreign R&D centers in India. These types of delineations helps to distinguish technological priorities, assess strengths and areas for joint collaboration.

7. Summary

This unit discusses the different technology indicators and highlights why patent is the most important technology indicator. Shows the key indications that can be derived from a patent document. Examples are given for highlighting the usage of patent based indicators.

Patents can analyze rate and direction of technical change an important part in the overall innovation process. Patent can be visualized as output of industrial R&D generated during the whole technology life cycle, they cover basic as well as incremental innovations. Detailed classification in patent documents allows unlimited choice of aggregation, from basic fields to technology down to single products.

The patent data cover virtually every field of technology although exhibiting strong skewness to some fields. Fields in which inventions can be quickly replicated have high intensity to patent to protect their invention. For example identification of molecule which is very effective for say a certain disease forms the most active ingredient of a drug. However, if competitors know this molecule, they can quickly produce the drug and thus all the investment and research efforts of the original firm are wasted. Through patent protection this type of infringement can be stopped. Say in other field like gearbox of a car, the complexity of the technology involved is difficult to replicate and patent if filed can give clues to other inventors to replicate. Hence patent is not a preferred mode for protection. This type of consideration applies to other fields also. Coca Cola ingredients are not patented and kept as trade secret as the company is afraid that patent specification will give clues to competitors to bring out similar non-infringing product.

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